InP Based Materials for Long Wavelength Optoelectronics Grown in a Multiwafer AIX 2400G3 Planetary Reactor¤

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Introduction

III-V compound semiconductors are the base of sophisticated optoelectronic and specialized electronic devices that can be found in numerous consumer products as well as in modern telecom and data transmission equipment. AIXTRON's patented Planetary Reactor, a unique and versatile multi-wafer MOCVD reactor available in various scaled configurations from 5x2" up to 35x2" or 5x6", meets nowadays production requirements of the III-V compound semiconductor industry. However, there is also a growing demand for InP based materials to be grown in multiwafer reactors in order to increase the throughput in the production of long wavelength optoelectronics devices.

Abstract

In this paper we will present reactor simulations and results of the growth of InP based materials ($Ga_xIn_{(1-x)}As_yP_{(1-y)}$) in a Planetary Reactor¤ . The reactor that has been used was an AIX 2400G3 system in the 8x3 inch configuration using 2 inch recesses.

Due to the high temperature sensitivity of the incorporation of the III-V species and the resulting material properties during the MOCVD growth process of multinary layers, as e.g. InGaAsP the temperature homogeneity on wafer for the production of high quality semiconductor devices is very important. Based on comprehensive reactor simulations a careful design of the induction coils and the internal structure of the graphite susceptor as shown in Fig. 1 has lead to a temperature uniformity in the growth zone in the AIX2400G3 of better than $\pm 1^\circ$ C. On the basis of this experience we will show data of GaInAsP grown on 8x2 inch InP Wafers of one run where we achieved for an average wavelength of 1486 nm an over all std. div. of 1.2 nm at 3 mm edge exclusion, measured in an Philips PLM100. Fig. 2 shows an ω-scan on a Philips XPert of an all quaternary MQW with 20 periods using material of 1.3 m emission wavelength for barriers and material of 1.1 m emission wavelength for wells. The MQW was grown without any growth interruption between well and barrier. This growth technique and the pressure identity between run and vent result in excellent interface sharpness. Furthermore we will show results from our still on going research and development on InP based materials.

The results demonstrate that Planetary Reactors¤ are an efficient tool for the mass production of GaInAsP alloys lattice matched to InP. The uniformity data show that the unique Planetary double rotation principle allows the growth of homogenous GaInAsP without any tuning of flow rates or gas velocities. Since the GaInAsP composition is very sensitive towards changes of the growth temperature, a very uniform wafer temperature is indicated. This is also confirmed by the excellent doping uniformity. Considering the high growth efficiency of these reactors (group III efficiency > 30%), we find that Planetary Reactors¤ are the ideal tool for a mass production of InP based compounds.

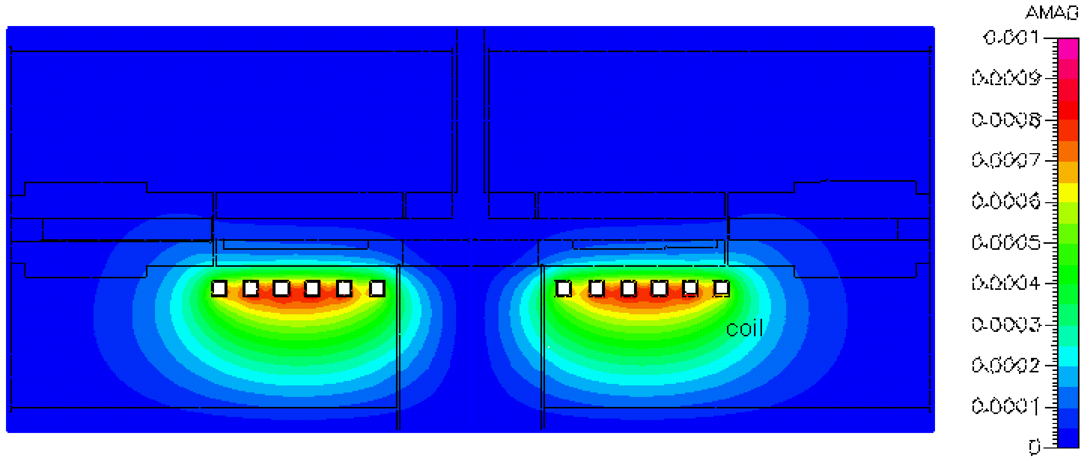

Fig. 1: Distribution of electromagnetic vector potential in the Planetary Reactor® (generic design).

Tab. 1: Data of 8x2" GaInAsP out of one Run with 3 mm edge exclution

8 wafers	Absolut	Std. Div. [nm]
Average [nm]	**1486.35**	**1.2**
Max [nm]	1488.04 (1.7nm)	1.39
Min [nm]	1484.91 (-1.4nm)	0.86

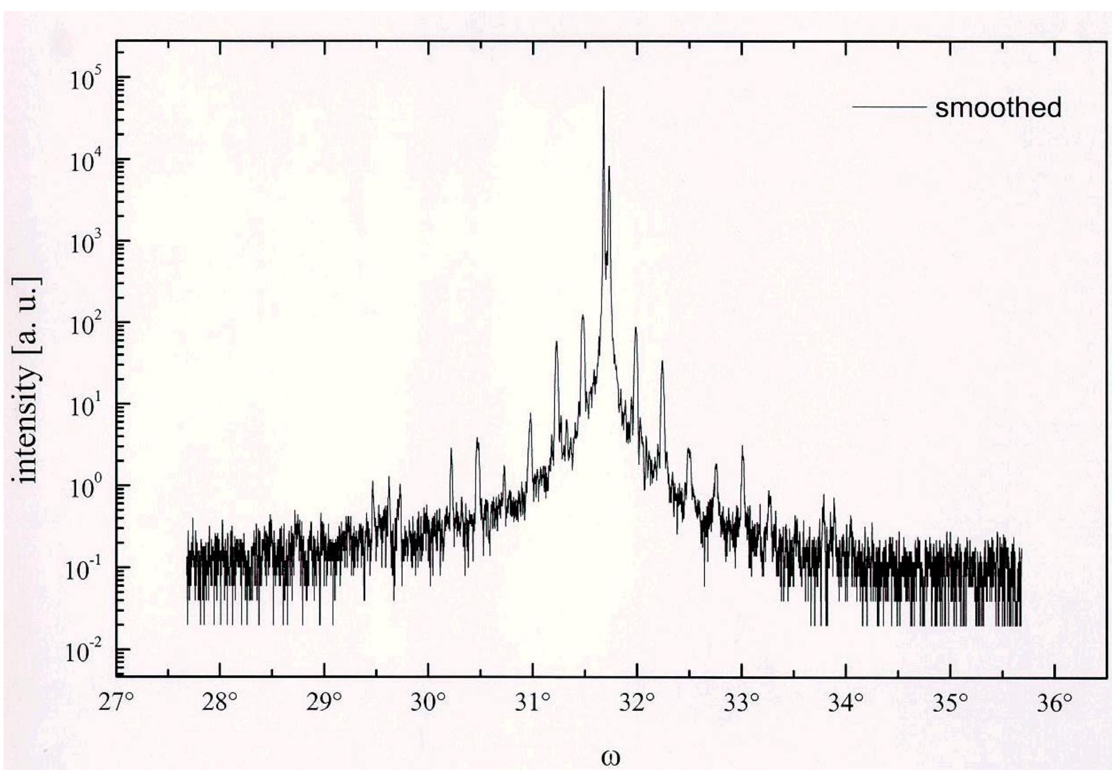

Fig. 2: XRD-data of a (GaInAsP~1.1 m) / (GaInAsP~1.3 m) MQW